Response to Concerns Regarding Road Density and Aquatic Species

Background
DNRC's current transportation system involves about 2,646 miles of roads in the HCP project area (Final EIS/HCP, Chapter 4, Table 4.4-6). About 700 miles of existing roads on HCP project lands are within 300 feet of a stream (Final EIS/HCP, Chapter 4, Table 4.8-7) and 240 miles of these are along known HCP fish species streams (Final EIS/HCP, Chapter 4, Table 4.8-7). DNRC would construct another 1,100 miles of new roads during the 50-year permit period. Road density overall in the HCP project area is 3.1 miles per square mile and would increase to 4.7 miles per square mile by the end of the Permit term, including abandoned and reclaimed roads (Final EIS/HCP, Chapter 4, Table 4.4-7). The majority of roads that occur in the HCP project area watersheds are of geology with parent materials of low to moderate erosion potential where sediment travel distances from forest roads are limited to drainage outfalls at stream crossings or if the road erosion rate is unusually high such as during active hauling during wet periods (Woods et. al 2006).

Overview of the Effects of Roads on Aquatic Environments
New roads within some portions of the HCP project area would likely change the natural hillslope drainage network and could accelerate erosion processes. These changes could alter or exacerbate the physical processes in nearby streams, leading to changes in streamflow regimes, sediment transport and storage, channel bed and bank configurations, substrate composition, and stability of slopes adjacent to the streams (MBTSG 1998; Furniss et al. 1991). These changes could potentially have significant effects for HCP fish species in the action area, particularly in watersheds where fish may already be stressed due to degraded habitat conditions.

High road densities can contribute to increased peak flows, but to varying degrees, and depending on local conditions. Scientific literature indicates variable responses of peak flows related to road density (peak flows exceeding a two-year recurrence interval) in the Pacific Northwest. While Jones and Grant (1996) identified increases in small peak flows (less than 2-year runoff events), this was not identified for larger peak flows (Thomas and Megahan 1998). In the Rockies, King and Tennyson (1984) studied road construction effects on peak flows in six watersheds and did not find any significant effect on flood flows.

McGreer et al. (1998) suggested that a cause-and-effect relationship of road impacts should not be attributed to road density because the impacts of roads on streams is predominantly dependent upon road location, design, construction, and maintenance practices. Some studies of these factors have shown that a cause-and-effect relationship exists only between road surface drainage characteristics and sediment delivery (Kirkby 1980, Megahan 1974, Reid and Dunne 1984, and Luce and Black 1999). Nevertheless, other studies have documented aquatic habitat or fish density changes associated with road density or indices of road density (Trombulak and Frissell 1999). Eaglin and Hubert (1993) showed a positive correlation with numbers of culverts and stream crossings and amount of fine sediment in stream channels, and a negative correlation with fish density and numbers of culverts on the Medicine Bow National Forest, Wyoming. Macro invertebrate diversity has also been demonstrated to be negatively correlated with an index of road density (McGurk and Fong 1995). Lee et al. (1997) concluded the best indicator of management intensity was predicted road density, and that overlaying road density on the location of key salmonid populations showed that the strongest populations occurred with areas of lowest road densities.

It seems reasonable to assume that watersheds with higher road densities would have greater potential to deliver sediment to nearby streams. The implication is that high road densities can be detrimental to fish resources in the affected streams. An environmental review published in the monthly newsletter of Environmental Science and Policy (Environmental Review 11. No. 5 May 2004) asked the question of Dr. Bruce Reiman, who is considered by the scientific community an expert on bull trout because of his extensive research, "How does road density affect bull trout?" The following is his answer:

"*At least in the data sets that we have worked with one of the best predictors of the status for bull trout populations is road density. There are lots of reasons why road density could be a good predictor of the status of the fish. Roads can influence erosion and therefore water quality, they can influence the timing and volume of runoff, they can be vectors for the introduction of nonnative species like brook trout, and roads can bring in fishermen. We don't know exactly what it is about roads, but there is a strong association between the status of bull trout populations and the density of roads in a given system. We've seen that in the broad picture across the Columbia River Basin and we've seen it in the work we've done in the Boise River Basin.*

The implication is that the kinds of things that come with roads can be detrimental to bull trout habitats, but it doesn't mean that if you build a road you're going to see a decline in bull trout. It just means that the probability of a negative effect increases."

Considering sediment impacts only, some research suggests that sediment production from forest roads is highly variable from road segment to road segment and that most road segments produce little sediment (Luce and Black 1999). McGreer et al. (1998) suggested that sources of sediment delivery from certain road segments in the Thompson River watershed in western Montana can be identified and therefore treated individually. For example, they found that nine individual locations delivered 76 percent of the total sediment volume in Boiling Springs Creek. On Goat Creek in the Swan Valley, five stream crossings contributed 70 percent of the total sediment delivered by roads to the watershed. In both the Goat Creek and Piper Creek watersheds, the majority of sediment was determined to come from a minority of stream crossings. Overall for both watersheds, less than 5 percent of road mileage was considered to actually deliver sediment to streams (Watson and Hillman 1997). This implies that managing sediment production of the few highest risk segments would be most efficient in preventing or reducing risk of sediment delivery to streams.

According to Baxter et al. (1999), in the Swan River sub-basin in Montana changes in bull trout redd densities over time were negatively correlated with road densities, and the protection of critical spawning tributary catchments from additional road building and associated land use disturbance will likely be necessary to maintain viable bull trout populations in the Swan River sub-basin. However, this bull trout core area population remains as one of the population strongholds throughout its entire range (as it has historically) with about 2000 adults (USFWS 2009). Redd counts are stable despite the existing high road densities. In fact, the major threat to this population is the recent population expansion of nonnative lake trout into the system (USFWS 2009). This indicates that the relationship between road densities and resiliency of bull trout populations is not entirely clear.

DNRC's existing road network includes roads constructed before establishment of state BMPs, which are probably the single greatest source of sediment input within the HCP project area. The reductions in sediment delivery predicted under the HCP (50 percent over the permit term or 10 percent per decade) could result in significant improvement in habitat conditions for HCP fish species. However, the magnitude of improvement may not be sufficient to benefit HCP fish species where baseline conditions are already highly degraded. Even small amounts of fine sediment delivered annually to a highly embedded stream can be enough to maintain degraded baseline conditions, which would not then benefit HCP fish species (Rhodes et al. 1994). In turn, relatively small shifts in fine sediment in spawning habitat can cause major changes in bull trout survival at the egg-fry stages (Weaver and Fraley 1991).Although substantial reductions in sediment delivery from roads are anticipated, the effect of the DNRC HCP on reduction of sediment in stream channels is unknown, because the response is likely to vary from stream to stream. Where sediment delivery to streams remains well-above the natural background rates, after BMPs are applied, a stream may still not have the capacity to transport the excess sediment out of the system in most years. Consequently, the recovery time could be very long in some cases (Rhodes et al. 1994). In such instances, applying additional sediment reducing measures, as well as not engaging in any sediment producing activities whatsoever, such as construction of new roads, may be the appropriate management action.

It is well established that forested roads generate erosion, and even in the presence of old roads that have been treated with BMPs and closed to traffic, sediment from these roads cannot be turned off all at once. Closing and upgrading existing roads and constructing new roads to higher standards in a damaged watershed may not be adequate in all cases to recover the watershed and associated fish habitat in time to allow a local population of a sensitive species, such as bull trout, to recover. Although some mechanisms of increased road surface erosion and hydrologic change can be minimized by BMPs, some mechanisms are inherent to watershed and site conditions (e.g., slope steepness, stream network density, and geologic instability) and are not readily controllable by BMPs or improved road design (USDA et al. 1993; Furniss et al. 1991; Packer 1967). The DNRC HCP attempts to take into account these site-specific conditions in degraded watersheds through the cumulative watershed effects analysis, the result of which would be improvement to the existing baseline by the implementation of site-specific measures (in addition to BMPs) as directed by a water resource specialist, especially at those sites that are most problematic.

The construction of 1,100 miles of new roads on DNRC HCP project lands could impact HCP fish species habitats in the affected reaches where road segments are constructed in close proximity to streams or at stream crossings. These impacts would be localized to the watersheds and local populations where the roads are built. Despite the estimates of increased sediment loads, the exact magnitude of sediment impacts resulting from new road construction under the HCP is difficult to discern and quantify because not all of the locations of new roads are known at this time, nor their design and development. For example, even though the HCP will attempt to minimize stream crossings, new roads will require fill to be used for the construction of additional stream crossings. How much of this fill will enter the stream and what its fate will be in terms of impacts on the aquatic system is difficult to predict. The effects of these added road miles and associated roadside ditches may substantially increase the drainage network on project lands. These roads may further cause compaction of forest soils, resulting in increased surface runoff which may contribute to increased stream peak flows. During normal high flow events, the added stream power may help mobilize coarse bedload, and depending on magnitude and timing, could cause potential physical displacement and/or direct mortality of bull trout and salmon eggs and juveniles.

With respect to the potential risk of impacts of roads under the DNRC HCP, no construction of new forest roads would be the only known way to ensure that no new or additional impacts to HCP fish species would occur, particularly in currently unroaded watersheds or drainage areas. Many adverse effects of roads cannot be fully minimized or successfully mitigated 100 percent (Furniss et al. 1991). Increasing road densities could increase the potential risk of land slides, road crossing failures, fill-slope failures, and debris avalanches, which can cause immediate sediment entry into fish bearing streams, as well as other impacts that result, directly or indirectly. Although roads can have very different effects on water resources depending on location and construction, all else being equal, higher total road densities in a watershed increase the risk to aquatic system functioning and associated fish resources than lower total road densities.

The Service believes that road density is a general indicator of potential watershed problems because road density is correlated with many types of watershed alterations, and it is useful when more specific indicators are not available. However, it is unknown and unproven that road densities *per se* cause fish populations to decline when roads exceed some specific density. Certain portions of road systems create the majority of negative effects associated with roads—those segments built on erodible soils, on steep or unstable slopes, and in close proximity to streams. Because of this, the DNRC HCP road commitments focus on specific problem road segments, road reclamation in locations where roads are not needed, and implementation of immediate corrective actions in high and moderate priority watersheds. For new roads, the commitments focus on avoiding roads in high erosion sites and SMZs, increased involvement by a water resource specialist for road construction when conditions warrant it, and development of site-specific BMPs when conditions warrant it.

DNRC HCP Effects Related to Road Density

The DNRC HCP includes commitments that would reduce road density, but it does not place a limit on road density. DNRC has unique needs as a state public agency with significant road access requirements such as: 1) accessing forest stands for management and hauling timber to market, 2) providing public access to various recreational resources, 3) patrolling forested areas for fire suppression, and 4) providing access to adjacent land ownerships. Road access agreements with private, county, and Federal landowners often have specific stipulations that mandate open vehicle access across some HCP lands. Due to these and other constraints, a strategy of managing impacts from roads through a road density threshold was not pursued. Instead, DNRC has committed to managing existing roads and newly constructed roads in ways that will reduce the direct (and indirect) impacts to HCP fish species and their habitat. These include the following:

- **Minimize the number of roads to those necessary to meet near- and long-term forest management needs.** To meet this requirement DNRC must confine road building to only those roads that are absolutely needed. Because road construction is included in the costs of a timber sale, more roads increase project development costs leading to lower market value of logs and less revenue for the school trusts. Additionally, once built, roads are a capital investment which requires funds for monitoring and maintenance. Under the HCP, DNRC has also committed, to the extent practicable, to avoiding road construction within riparian zones and on high hazard sites prone to mass failure; and to removing road segments from riparian areas whenever the opportunity and resources allow.

- **Reduce potential sediment delivery from existing road sources to streams supporting HCP fish species.** To reduce sediment delivery from existing road sources DNRC primarily uses applicable Montana Forestry BMPs. Road inspections and other road inventory activities are the primary mechanism used to identify existing and potential sources of road erosion and sediment delivery to streams. DNRC typically implements actions aimed at reducing or eliminating identified or potential sources of sediment from existing roads at the project level. These actions usually consist of various road improvements, road maintenance activities, and road upgrades that have been identified within the project area and are intended to bring the existing roads up to a standard that complies with BMPs. The HCP enhances the existing strategy by including commitments that establish: a timeline for completing road inventories in watersheds supporting HCP fish species; a prioritization scheme for implementing corrective actions; and a timeline for identifying and implementing corrective actions.

- **Construct, reconstruct, maintain, abandon, reclaim, and use roads with practices and measures that reduce the risk of sediment delivery to streams supporting HCP fish species.** DNRC applies the SMZ Law and ARMs and applicable Montana Forestry BMPs when addressing all road management actions. The SMZ Law and ARMs regulate road-related activities conducted immediately adjacent to streams, lakes, and other bodies of water. One of the primary objectives of the SMZ Law is to provide effective sediment filtration from forest road related activities to maintain high water quality. For example, the SMZ Law prohibits the construction of roads in an SMZ except when necessary to cross a stream and prohibits road fill material from being deposited within an SMZ during road construction, except as necessary to construct a stream crossing. Under the HCP, DNRC would enhance its existing practices by doing the following: 1) requiring a water resource specialist review of proposed road activities potentially affecting HCP fish species habitat to provide direction for appropriate sediment abatement measures, 2) as needed, designing and implementing site-specific mitigation measures above and beyond standard BMPs, and 3) conducting adequate monitoring and adaptive management on both the implementation and effectiveness of the road management conservation measures in order to improve implementation of the measures or to make adjustments as necessary.

- **Conduct timber harvest and associated operations (site preparation, slash treatment, reforestation) with practices and measures that reduce the risk of sediment delivery to streams supporting HCP fish species.** DNRC timber harvest, yarding, landing, site preparation, and slash treatment operations are designed to implement all appropriate Montana Forestry BMPs. The proper application of appropriate BMPs has been repeatedly demonstrated to minimize sediment transport and delivery from timber-harvest-related activities. As mentioned above, the SMZ Law and ARMs regulate timber harvest activities conducted immediately adjacent to streams, lakes, and other bodies of water. Provisions of the HCP that enhance existing practices include: 1) providing a process for ensuring adequate review by a DNRC water resource specialist of harvest activities potentially affecting HCP fish species habitat, 2) designing and implementing site-specific mitigation measures, and 3) providing adequate feedback using both implementation and effectiveness monitoring in order to adapt future BMPs.

- **Conduct gravel excavation, processing, hauling, and use for DNRC forest management projects with practices and measures that reduce the risk of sediment delivery to streams supporting HCP fish species.** DNRC will not develop gravel pits within SMZs and RMZs (with the allowance for one medium-sized pit in an RMZ in the Stillwater Block and Swan Unit). DNRC will design and implement site-specific BMPs and other mitigation measures to reduce the risk of sediment delivery to streams affecting HCP fish species from all gravel pits. A DNRC water resource specialist will make recommendations that will be integrated into the development of contract specifications, permits, and Plans of Operation

As described above and in the Service's forthcoming BO, the DNRC HCP would manage specific impacts of roads by implementing a suite of measures that would reduce the potential risk of sediment delivery to a stream. These collective actions are expected to adequately minimize and mitigate effects of impacts from roads on HCP fish species and their habitats. The HCP also includes sufficient adaptive management flexibility to ensure that, in those cases where the proposed approach is not as effective as necessary in conserving HCP fish species, management can be modified as necessary.

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